DRILTEK
PROFESSIONAL OPERATIONS MANAGEMENT

Project: San Joaquin Renewables, Class VI UIC Application

Location: Kern County, California

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Subject: Recommended Pre-Injection Logging and Testing Program

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I. Preoperational Formation Testing

Recommended pre-operational formation testing includes a suite of logging, coring, geohydrologic testing and other activities during the drilling and completion of the well. Electrical logging will support reservoir rock and fluid properties characterization. Formation pressure testing will determine current reservoir pressure and permeability.

The other pre-operational tests will determine the depth, thickness, mineralogy, lithology, porosity, permeability, and geomechanical attributes of the "Vedder" sandstone (target injection zone), and the overlying "Pyramid Hills", "Freeman-Jewett", "Olcese" and "Round Mountain" formations. The results of the testing activities will be documented in a report and submitted to the U.S. EPA after the well drilling and testing activities have been completed, but before carbon dioxide injection commences.

II. Wireline Logging Program

Wireline logging of the injection well will consist of conventional and advanced open-hole logs of the surface, intermediate, and injection hole sections. Cement bond logs will be run on the surface, intermediate and injection casing sections to verify cement integrity and zonal isolation. A pulsed neutron capture log should be run on the injection hole to provide a baseline water-to-gas saturation to support saturation and injection modeling over the life of the project.

Recommended Logging Program, by hole or casing section

Surface Hole Section

- Triple combo – GR, neutron porosity, bulk density, resistivity

Intermediate Hole Section

- Triple combo - GR, neutron porosity, bulk density, resistivity
- Dipole full-wave sonic – rock properties and seismic tie-in
- Spectral gamma ray
- NMR – movable fluids and permeability modeling
- Resistivity based image log – facies, fracture identification, fault identification

Injection Hole Section

- Triple combo - GR, neutron porosity, bulk density, resistivity
- Dipole full-wave sonic – rock properties and seismic tie-in
- Spectral gamma ray
- NMR – movable fluids and permeability modeling
- Formation pressure testing – reservoir pressure and permeability indicator
- Resistivity based image log – facies, fracture identification, fault identification

Surface Casing

- Cement bond log with variable density
- Cased hole pressure and temperature

Intermediate Casing

- Cement bond log with variable density
- Radial mapping – to determine if cement channeling exists
- Cased hole pressure and temperature

Injection Casing

- Cement bond log with variable density
- Radial mapping – to determine if cement channeling exists
- Cased hole pressure and temperature
- Pulsed neutron capture log – baseline gas saturation to calibrate against open hole logs and for an initial measurement for future time lapse gas injection mapping

III. Coring Program

Several 30' whole cores should be taken to evaluate fluid and rock properties to calibrate against open hole logs. The objective of the coring zones is to determine the nature of sand reservoir containers and their transitions to shales. Cores should be taken across sealing interfaces and across the injection zones. Targets include the "Freeman-Jewett" to "Pyramid Hill", "Vedder 1" through "Vedder 3", the "Round Mountain" to "Olcese" expansion zone interface, and the "Vedder 2" shale to "Vedder 3" sand interface.

Proposed Coring Zones[1]

- "Round Mountain" into "Olcese"
- "Olcese" into "Freeman-Jewett"
- "Freeman-Jewett" into "Pyramid Hills"
- "Pyramid Hills" into "Vedder 1"
- "Vedder 2" into "Vedder 2" shale
- "Vedder 2" shale into "Vedder 3"

Proposed Core Analyses:

- Porosity
- Permeability to air
- Saturations
- Grain density – to calibrate porosity logs
- Gamma ray – to correlate to open hole logs
- Core descriptions
- Computerized tomography (CT) scanning before slabbing to ensure core quality

Proposed Special Core Analysis:

- Capillary pressure on select plugs to determine pore throats and relate water saturations to permeability (K) and porosity (ϕ)
- X-ray diffractograms (XRD) to determine clay mineralogy and validate petrophysical clay volume calculations
- CO_2 to water relative permeability
- Geomechanical measurements of containment and injection zones
- Tri-axial stress test to validate frac pressure
- Pore compressibility
- Thin section and scanning electron microscopy (SEM) analyses

[1] See Figure 1

Proposed Wellbore Schematic

CO2 Injection Well
Two Injection Zones, Two Strings
Short String: Pyramid Hill + Vedder 1 + Vedder 2
Long String: Vedder 3

Frontline BioEnergy

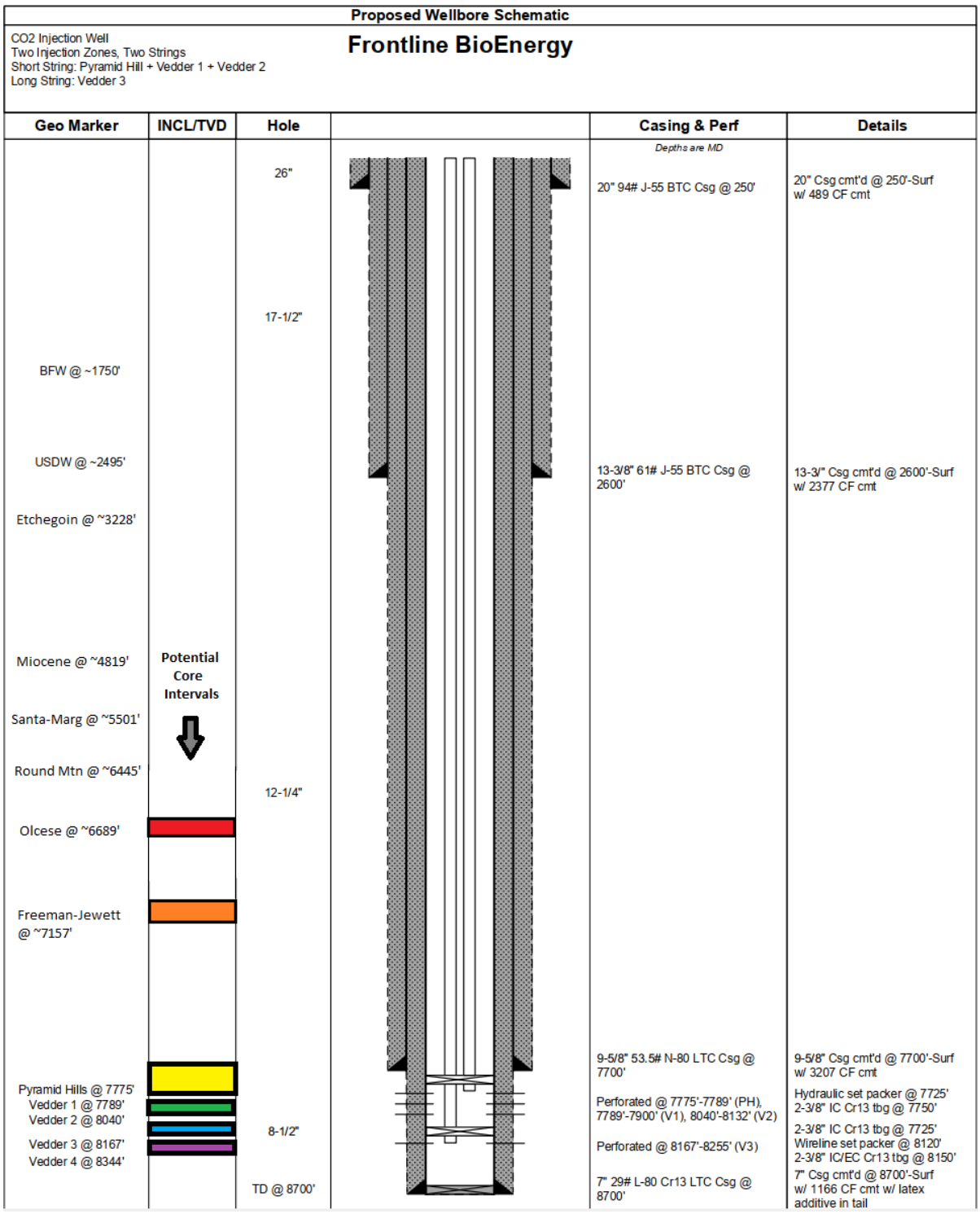

Figure 1 - Proposed Injector Casing Design with Geologic Markers